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EPA Coalbed Methane Outreach Program Technical Options Series

USE OF COAL MINE METHANE IN BLAST FURNACES

Gas injection systems increase the iron-making productivity of blast furnaces while lowering costs
(Photo Courtesy of American Iron and Steel Institute)

POTENTIAL BENEFITS OF INJECTING COAL MINE METHANE IN BLAST FURNACES...

- Reduces coke usage and improved furnace stability
- Increases iron-making productivity and reduced operating costs
- Reduces air pollution from coke
- Recovery and use of coal mine methane reduces greenhouse gas emissions

Why Consider Using Coal Mine Methane in Blast Furnaces?

Using coal mine methane as fuel, rather than venting it to the atmosphere, reduces methane emissions

The steel industry uses blast furnaces to transform iron ores into molten iron, which is later used for steelmaking. Blast furnace operations use metallurgical coke to produce most of the energy required to melt the ore to iron. Currently, U.S. steelmakers produce approximately 55 million tons of molten iron annually, requiring about 23 million tons of coke per year. However, coke is becoming increasingly expensive since coke production is declining for various reasons. Since blast furnaces will continue to be the major process for producing iron in the United States, the steel industry is seeking low-capital options that reduce coke consumption, increase productivity, and reduce operating expenses.

Blast furnaces near gassy coal mines may be able to use coal mine methane to offset a portion of their natural gas needs

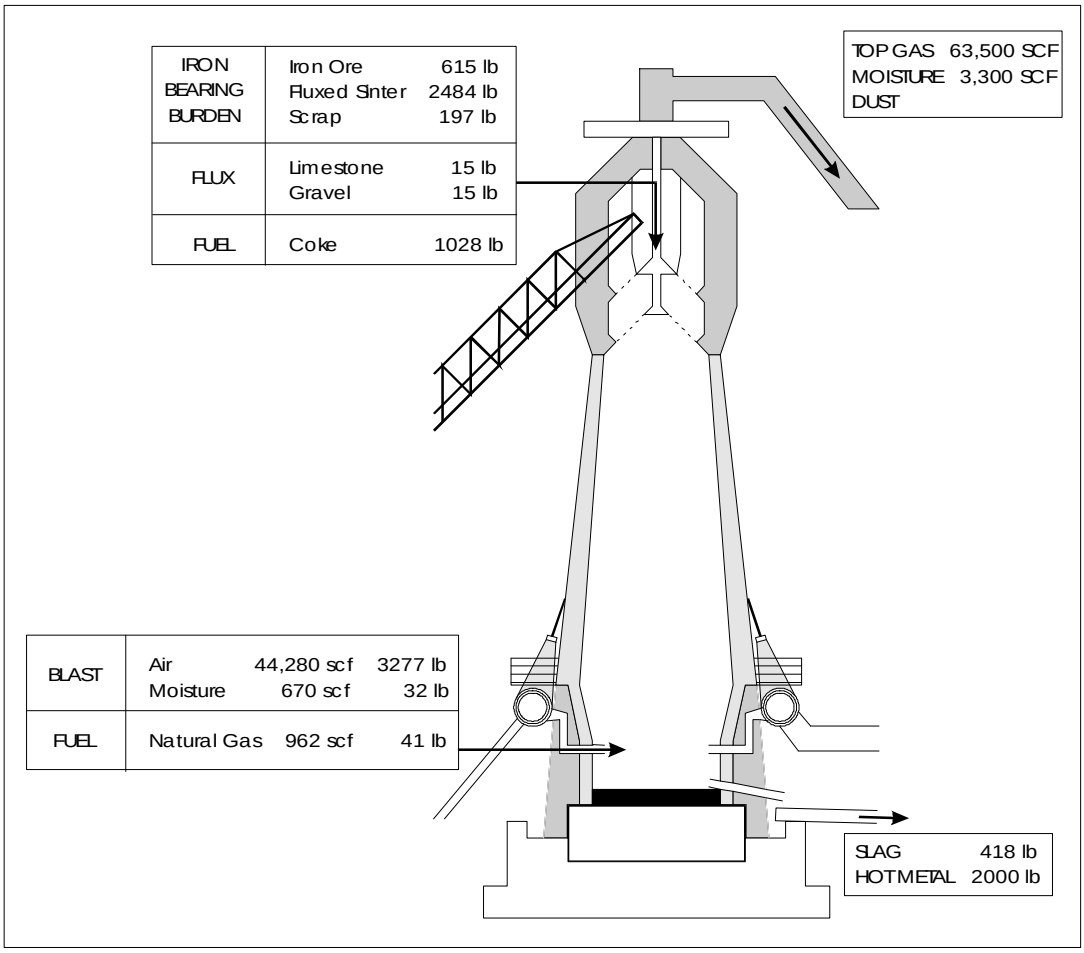
All blast furnaces in North America inject some type of supplemental fuel, such as natural gas, coke oven gas, oils and tars, or coal to form additional carbon monoxide and hydrogen for combustion, and chemical reduction of iron-bearing materials into molten iron. Of these fuels, natural gas and pulverized coal are the most widely accepted for injection. Recent full-scale tests have shown that injecting natural gas into blast furnaces at the rate of 6,900 standard cubic feet per ton of hot metal (scf/thm) can reduce coke consumption by 30%, and can increase ironmaking production by 40%. Injecting natural gas, rather than coal or coke oven gas, as a supplemental fuel also reduces NOx and SOx emissions. Coal mine methane provides the same benefits as conventional natural gas, and could easily be substituted for, or mixed with, natural gas for blast furnace use, as long as it meets gas quality requirements (it must have a low sulfur content and contain at least 94% methane).

In the U.S., several blast furnaces that currently inject natural gas are located within approximately 20 miles of gassy coal mines. Because most gassy coal mines drain less than 10 million cubic feet of methane per day, they do not produce enough methane to meet all the gas requirements of a typical blast furnace, but one or more gassy mines could produce enough methane to supplement a blast furnace's gas needs. A preliminary review suggests that a dedicated pipeline project delivering coal mine methane to a blast furnace is not likely to be economically viable. However, this review did not take into account many variables, including a steel company's interest in greenhouse gas reduction credits, locations of existing pipelines with respect to the blast furnaces, and the potential for innovative strategies for transporting methane from a mine to a blast furnace. These site-specific conditions could improve the economics of using coal mine methane in blast furnaces. Internationally, there may be additional opportunities for the use of coal mine methane in blast furnaces, as in many countries, large metallurgical industries are located near coal mines.

The cost of coal mine methane is often less than conventional natural gas

Several companies are currently reporting their methane emissions reductions under the DOE-sponsored "Voluntary Reporting Program" for greenhouse gas emissions. At present, these emissions reductions do not have an established market value. However, at least two companies, Niagara Mohawk Power Corp. and Suncor Energy Inc., have taken a first step toward the creation of a global market and an international trading system for reductions in emissions

of greenhouse gases, such as methane and carbon dioxide. Specifically, Suncor Energy has agreed to purchase greenhouse gas emission reductions from Niagara Mohawk. Steel companies wishing to participate in a greenhouse gas emissions reduction program may wish to use coal mine methane to offset a portion of their fuel needs.



Schematic of a typical blast furnace injecting natural gas (962 scf per ton of hot metal)
The process places iron ore, coke and other fluxing substances into the furnace top *(upper left diagram)* while blowing a blast of hot air enriched with natural gas into the furnace bottom *(lower left)*. The coke generates gases that reduce the ore, creating molten iron and slag *(lower right)*. The process also produces blast furnace gas, or "top gas" *(upper right)* that is suitable for use in the furnace stoves or elsewhere in the plant.

	No Gas Injection	1780 scf gas per ton of hot metal	3340 scf gas per ton of hot metal	5800 scf gas per ton of hot metal
Metal production (tons/day)	2,589	2,918	3,124	3,452
Coke cost ($/THM)	$59.00	$52.00	$48.00	$41.00
Natural gas cost ($/THM)	$0	$3.80	$7.50	$12.60
Oxygen Cost ($/THM))	$0	$0.10	$2.60	$4.90
Iron Ore Pellets ($/THM)	$57.80	$57.60	$57.70	$57.70
Total Cost ($/THM)	$117.00	$113.50	115.80	$116.20
Cost Savings ($/Day)	--	$10,740	$4,280	$2,420

Increased Production ($/Day)	--	$32,900	$53,500	$86,300
Total Benefits ($/Day)	--	$43,460	$57,780	$88,720
Material Costs: Coke - $115/ton; Natural gas - $2.20/mcf; Oxygen - $35/ton; Ore pellets - $38/ton				
Abbreviations: scf – standard cubic feet; THM - tons of hot metal; mcf - thousand cubic feet				
All data derived from Gas Research Institute Report, "Natural Gas Injection in Blast Furnaces"				

For More Information…

Rapidly changing environmental regulations and market conditions are creating new opportunities for distribution and use of coal mine methane. Blast furnaces are a high-volume gas consumer that could benefit from using coal mine methane to meet a portion of their fuel needs. The use of coal mine methane, like conventional natural gas, reduces coke consumption, and therefore NOx, SOx, and CO_2 emissions. In addition to these benefits, the use of coal mine methane reduces methane emissions.

To obtain more information about using natural gas in blast furnaces, contact:

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Or contact EPA's Coalbed Methane Outreach Program for information about this and other profitable uses for coal mine methane:

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EPA COALBED METHANE OUTREACH PROGRAM